Stoller
Grand Junction Office established 1959

299-E33-5 (A4870)
Log Data Report

Borehole Information:

Borehole:	299-E33-5 (A4870)		Site:	216-B-47 Crib	
Coordinates (WA State Plane)		GWL (ft)[1]:	237.38	GWL Date:	9/2002
North	East	Drill Date	TOC[2] Elevation	Total Depth (ft)	Type
137,606.42 m	573,574.23 m	June 1955	194.47 m	243.6	Cable Tool

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Welded Carbon Steel	2.5	8.625	8.00	0.3125	0	238.5
Welded Carbon Steel	0.5	4.50	4.00	0.25	2	214.5

The logging engineer measured the casing stickup between the concrete pad and the top of the casing using a steel tape. The inside and outside diameters of the 8-in. casing were measured with a steel tape, and the thickness was calculated. The 4-in. casing and bottom of casings are as reported on the well as-built (Ledgerwood 1993). It appears the 4-in. casing bottom is at 219.0 ft. The 8-in. casing bottom is probably at 243.0 ft. The bottom reported by Duratek Federal Services (243.60 ft) is approximately 4.1 ft deeper than the reported completion depth of 239.5 ft.

Borehole Notes:

Borehole coordinates, elevation, and well construction information, as shown in the above tables, are from measurements by Stoller and Duratek Federal Services field personnel and Ledgerwood (1993). The depths have been adjusted to TOC. Zero reference is the top of the 8-in. casing. TOC stickup is evenly cut. A reference point survey "X" is located on TOC stickup. Surrounding the casing, a 4-ft x 4-ft x 6-in. concrete pad covers the ground surface. The concrete pad sits on top of approximately 3 ft of sand and gravel that was used as a cap over the crib or original ground surface. Grout extends to 214.5 ft (Ledgerwood 1993).

Logging Equipment Information:

Logging System:	Gamma 2B		Type:	SGLS (35%)
Calibration Date:	09/2002	Calibration Reference:	GJO-2002-287-TAR	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4	
Date	10/01/02	10/02/02	10/02/02	10/03/02	
Logging Engineer	Spatz	Spatz	Spatz	Spatz	
Start Depth (ft)	3.0	243.0	219.0	72.0	
Finish Depth (ft)	116.0	218.0	115.0	47.0	
Count Time (sec)	200	100	200	200	
Live/Real	R	R	R	R	

Log Run	1	2	3	4	
Shield (Y/N)	None	None	None	None	
MSA Interval (ft)	1.0	0.5	1.0	1.0	
ft/min	n/a[3]	n/a	n/a	n/a	
Pre-Verification	BB142CAB	BB143CAB	BB143CAB	BB144CAB	
Start File	BB142000	BB143000	BB143051	BB144000	
Finish File	BB142113	BB143050	BB143155	BB144025	
Post-Verification	BB142CAA	BB143CAA	BB143CAA	BB145CAA	
Depth Return Error (in.)	-0.5	n/a	0	+1	
Comments	No fine-gain adjustments.	No fine-gain adjustments.	Fine-gain adjustments (see below).	Repeat section. No fine-gain adjustments.	

Logging Operation Notes:

Zero reference was top of the 8-in. casing. Logging was performed without a centralizer installed on the sonde. Pre- and post-survey verification measurements for the SGLS employed the Amersham KUT (^{40}K, ^{238}U, and ^{232}Th) verifier with serial number 082. The count rate dropped approximately 40 counts per second (cps) at 219 ft, which appears to be the bottom of the 4-in. casing. A new log run was started at 219 ft using a 200-sec counting time to compensate for the second casing. Fine-gain adjustments were made after files BB143105 (165.0 ft), BB143127 (142.0 ft), BB143140 (130.0 ft), BB143140 (130.0 ft), and BB143149 (122.0 ft).

Analysis Notes:

Analyst:	Sobczyk	Date:	10/15/02	Reference:	GJO-HGLP 1.6.3, Rev. 0

SGLS pre-run and post-run verification spectra were collected at the beginning and end of each day. The verification spectra were all within the control limits. Two of the post-run verification spectra were within the upper and lower control limits but significantly lower than the pre-run values. The peak counts per second at the 609- keV, 1461-keV, and 2615-keV photopeaks on the post-run verification spectra as compared to the pre-run verification spectra for each day were generally lower and between 2 and 13 percent of one another. Examination of spectra indicates that the detector appears to have functioned normally during all of the logging runs, and the spectra are provisionally accepted, subject to further review and analysis.

Log spectra for the SGLS were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source file: G2BSep02.xls), using parameters determined from analysis of recent calibration data. Zero reference was the top of the 8-in. casing. The casing configuration was assumed to be a string of 8-in. casing with a thickness of 0.3125 in. to total depth (243 ft) and a string of 4-in. casing with a thickness of 0.25 in. to a log depth of 219 ft. These casing thicknesses were measured by the logging engineer. Where more than one casing exists at a depth, the casing correction is additive (e.g., the correction for both an 8-in. and 4-in. casing would be 0.3125 + 0.25 = 0.5625). A water correction was applied to the SGLS data below 237.4 ft.

Dead time corrections are required when dead time exceeds 10.5 percent. Dead time exceeded 10.5 percent in the interval from 53 to 55 ft. Maximum dead time was about 31 percent at 54 ft. At SGLS dead time greater than 40 percent, peak spreading and pulse pile-up effects may result in underestimation of activities.

Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides (^{40}K, ^{238}U, and ^{232}Th), and man-made radionuclides. Plots of the repeat logs versus the original logs are included. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The ^{214}Bi peak at 1764 keV was used to determine the naturally occurring ^{238}U concentrations on the combination plot rather than the ^{214}Bi peak at 609 keV because it exhibited slightly higher net counts per second.

Results and Interpretations:

^{137}Cs, ^{60}Co, and ^{125}Sb were the man-made radionuclides detected in this borehole. ^{137}Cs was detected in four intervals: from 3 to 9 ft, from 50 to 65 ft, from 94 to 95 ft, and from 213 to 229.5 ft. The maximum apparent activity was 840 pCi/g at a log depth of 53.0 ft. ^{137}Cs was also detected at 87.0 and 152 ft with concentrations near the MDL (0.3 pCi/g). ^{60}Co was detected in six intervals: from 50 to 58 ft, from 65 to 69 ft, from 78 to 81 ft, from 86 to 134 ft, from 142 to 171 ft, and from 231.5 to total depth (243 ft). The range of concentrations was from the MDL (0.1 pCi/g) to 24.6 pCi/g, which was detected at 99 ft. ^{60}Co was detected below the groundwater depth of 237.4 ft. ^{125}Sb was detected in the interval from 94 to 96 ft at concentrations ranging from 2.5 pCi/g to 9.0 pCi/g.

Comparison log plots of data collected in 1991 and 1994 by Westinghouse Hanford Co. (WHC), in 1997 by Waste Management Federal Services NW, and in 2002 by Stoller are included. The Radionuclide Logging System (RLS) concentration data for ^{60}Co, ^{125}Sb, and ^{137}Cs are decayed to the date of the SGLS logging event in October 2002. The SGLS and 1991 and 1994 RLS logs appear to use a different depth reference, and the logs were shifted 5.0 and 2.5 ft, respectively. Since 1991, ^{137}Cs and ^{125}Sb activities appear to have decreased as predicted by radioactive decay. Above 140 ft, ^{60}Co activities appear to have decreased as predicted by radioactive decay since 1991. A significant influx of ^{60}Co appears to be occurring between 142 and 171 ft, as only trace amounts of ^{60}Co were detected in 1991. On the basis of 1991, 1997, and 2002 logs and accounting for radioactive decay, apparent ^{60}Co concentrations appear to be increasing in this interval; this interval was not logged in 1994. Below 240 ft, ^{60}Co concentrations are slightly higher than that predicted by decay or differences in the casing correction when compared to the 1991 log, and this interval was not logged in 1994 and 1997. This possible change may be the result of different depth references.

Recognizable changes in the KUT logs occurred in this borehole. However, these changes are more indicative of the well completion materials than the surrounding formation. The reported top of basalt (Ledgerwood 1993) is at about 238.5 ft (TOC).

The plots of the repeat logs demonstrate reasonable repeatability of the SGLS data for both the man-made and natural radionuclides (661, 1173, 1333, 609, 1461, 1764, and 2614 keV).

Gross gamma profiles from Additon et al. (1978) (attached) indicate that the sediments surrounding this borehole contained significant amounts of gamma-emitting contamination found in 1959 through at least 1976. The profile from 5/4/59 detected gamma activity above background in the intervals from 13 to 118 ft (4 to 36 m) and below 207 ft (63 m). The profile from 5/4/76 detected gamma activity above background in the intervals from 39 to 121 ft (12 to 37 m) and below 223 ft (68 m). The SGLS detected ^{137}Cs, ^{60}Co, and ^{125}Sb between 50 and 134 ft and ^{137}Cs and ^{60}Co below 213 ft. Gross gamma profiles from 5/4/59, 5/23/63, 4/27/70, and 5/4/76 suggest only background radioactivity in the interval between 142 and 171 ft (43 and 52 m), while the SGLS detected ^{60}Co in this interval.

Because of this borehole's close proximity to the 241-BY Tank Farm and the BY Cribs, it is recommended that this borehole is logged periodically to monitor the changes observed in contaminant profile over the last 10 years. The interval from 140 ft to total depth should be logged again in 2 years with the SGLS.

References:

Additon, M.K., K.R. Fecht, T.L. Jones, and G.V. Last, 1978. *Scintillation Probe Profiles From 200 East Area Crib Monitoring Well*s, RHO-LD-28, Rockwell Hanford Operations, Richland, Washington.

Ledgerwood, R.K., 1993. *Summaries of Well Construction Data and Field Observations for Existing 200-East Resource Protection Wells*, WHC-SD-ER-TI-007, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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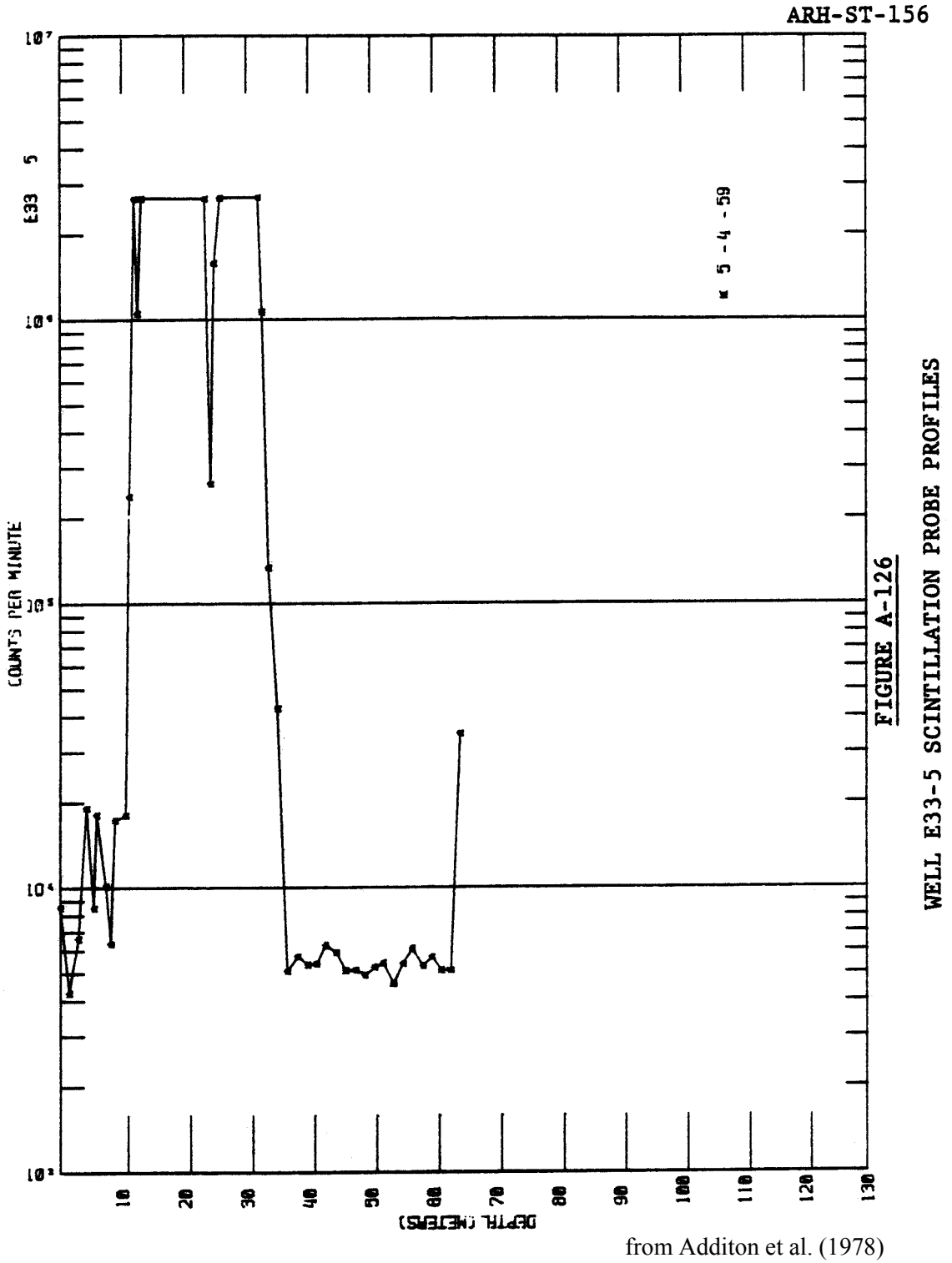
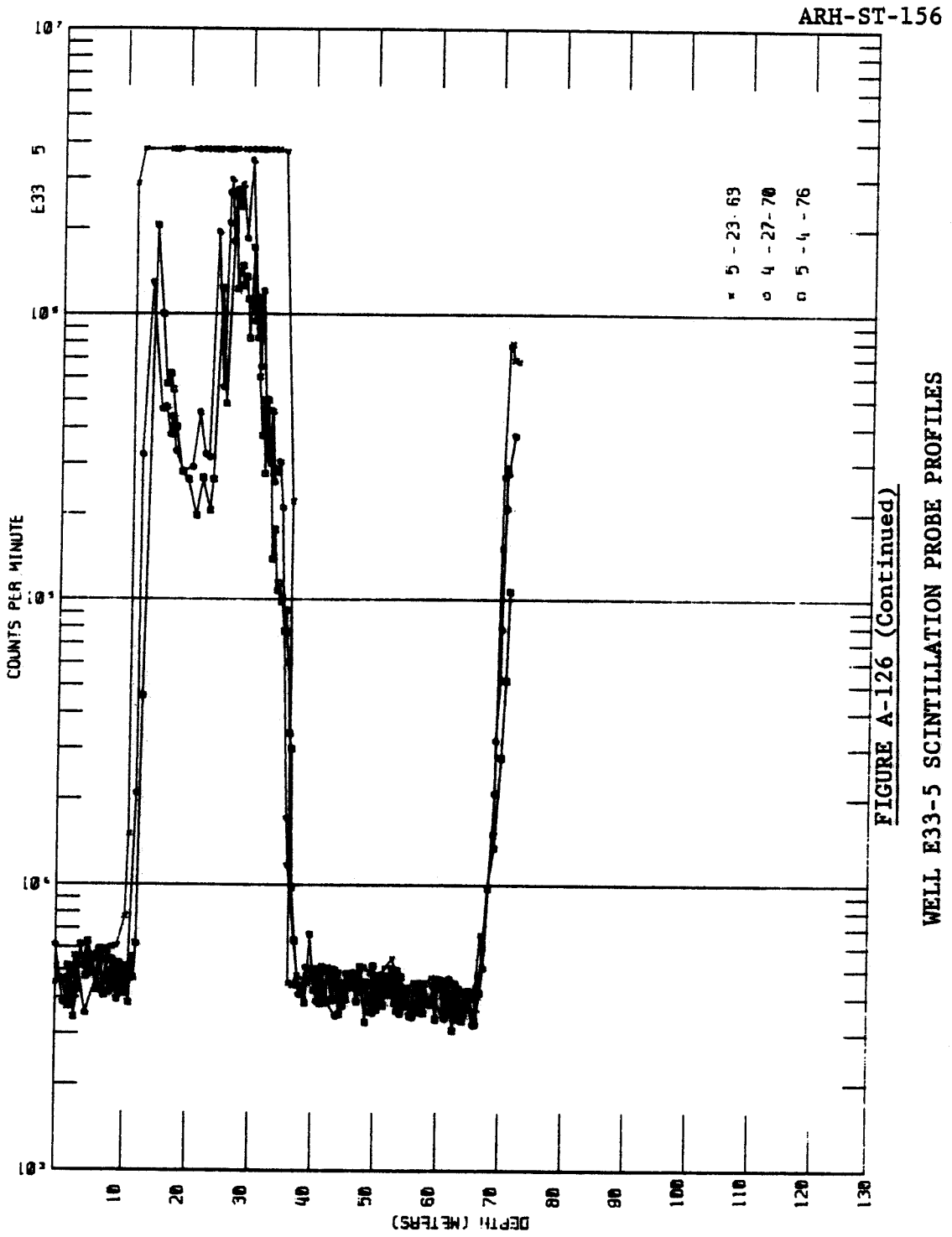
[1] GWL – groundwater depth
[2] TOC – top of casing
[3] n/a – not applicable



from Additon et al. (1978)

Scintillation Probe Profile for Borehole 299-E33-5, Logged on 5/4/59

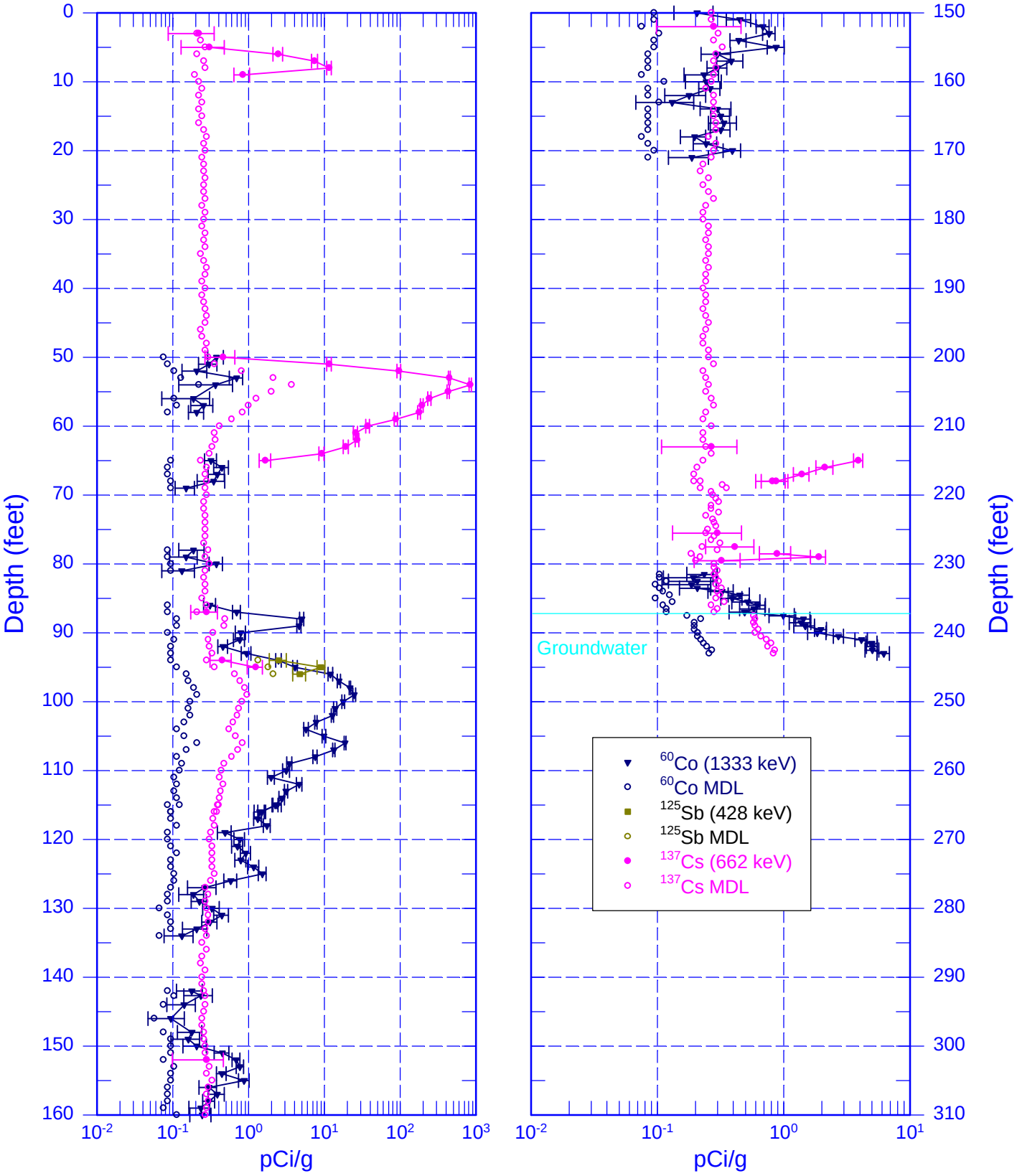


from Additon et al. (1978)

Scintillation Probe Profiles for Borehole 299-E33-5, Logged on 5/23/63, 4/27/70, and 5/4/76

299-E33-5 (A4870)

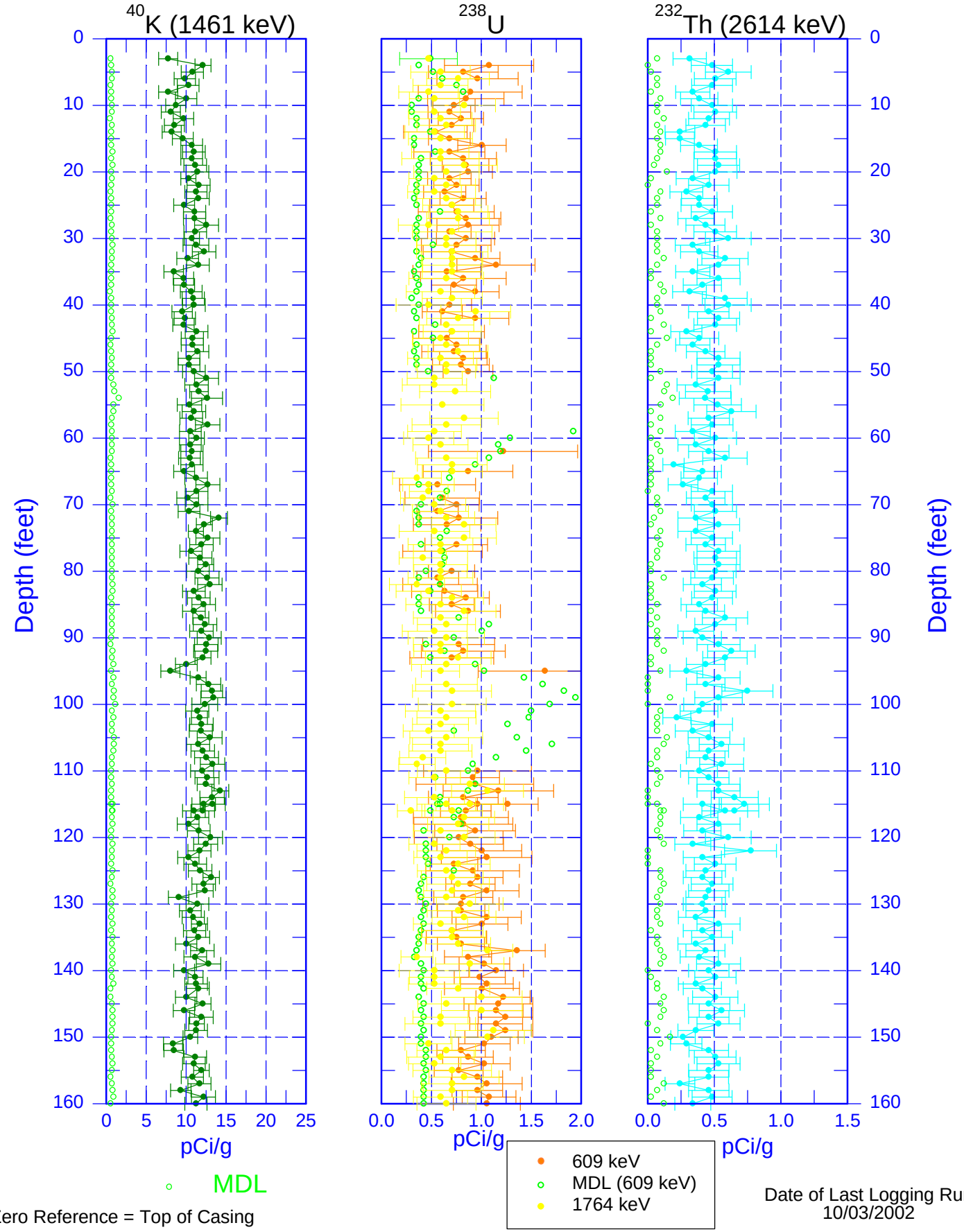
Man-Made Radionuclides



Zero Reference = Top of Casing

Date of Last Logging Run
10/03/2002

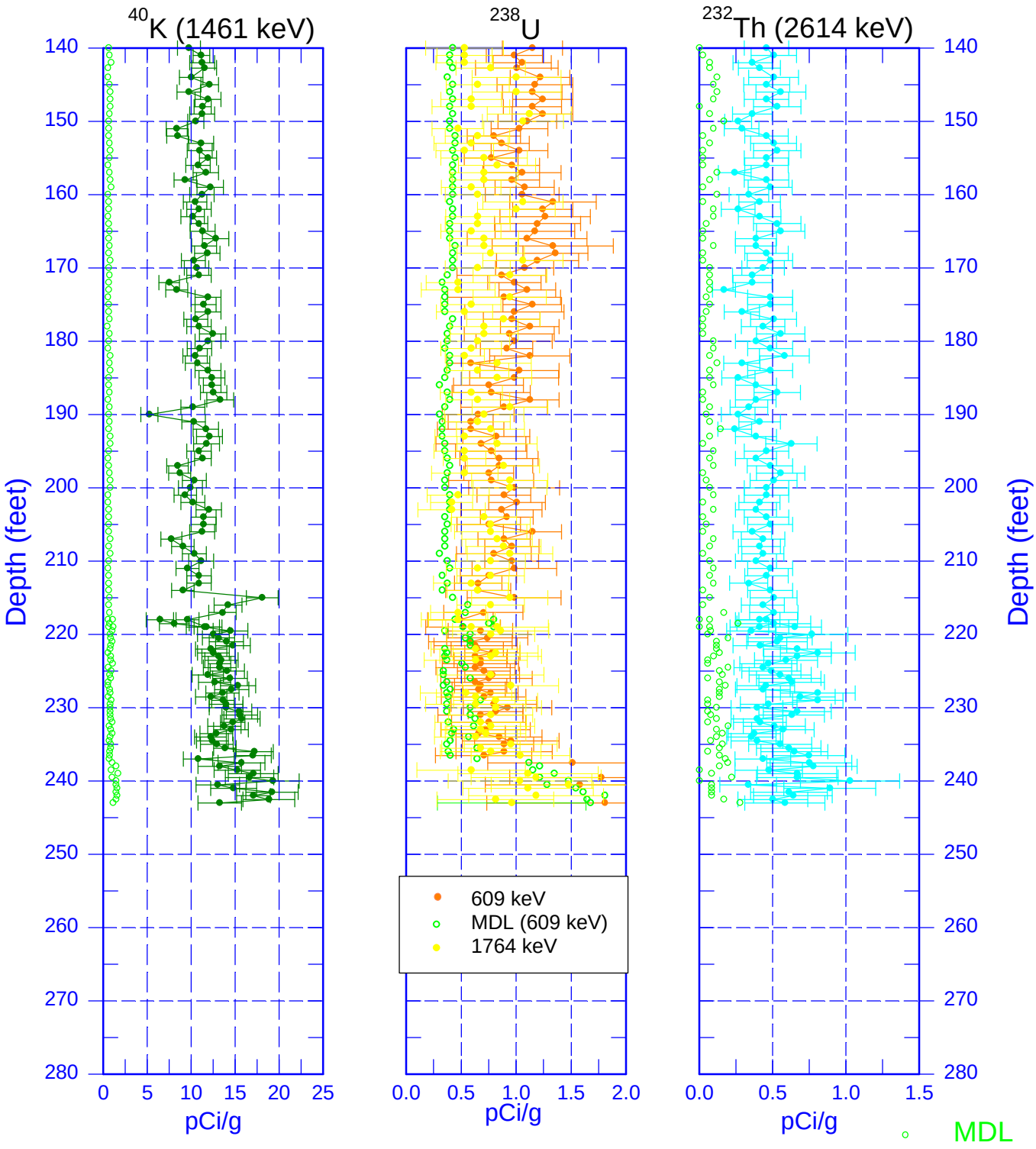
299-E33-5 (A4870)
Natural Gamma Logs



Zero Reference = Top of Casing

Date of Last Logging Run
10/03/2002

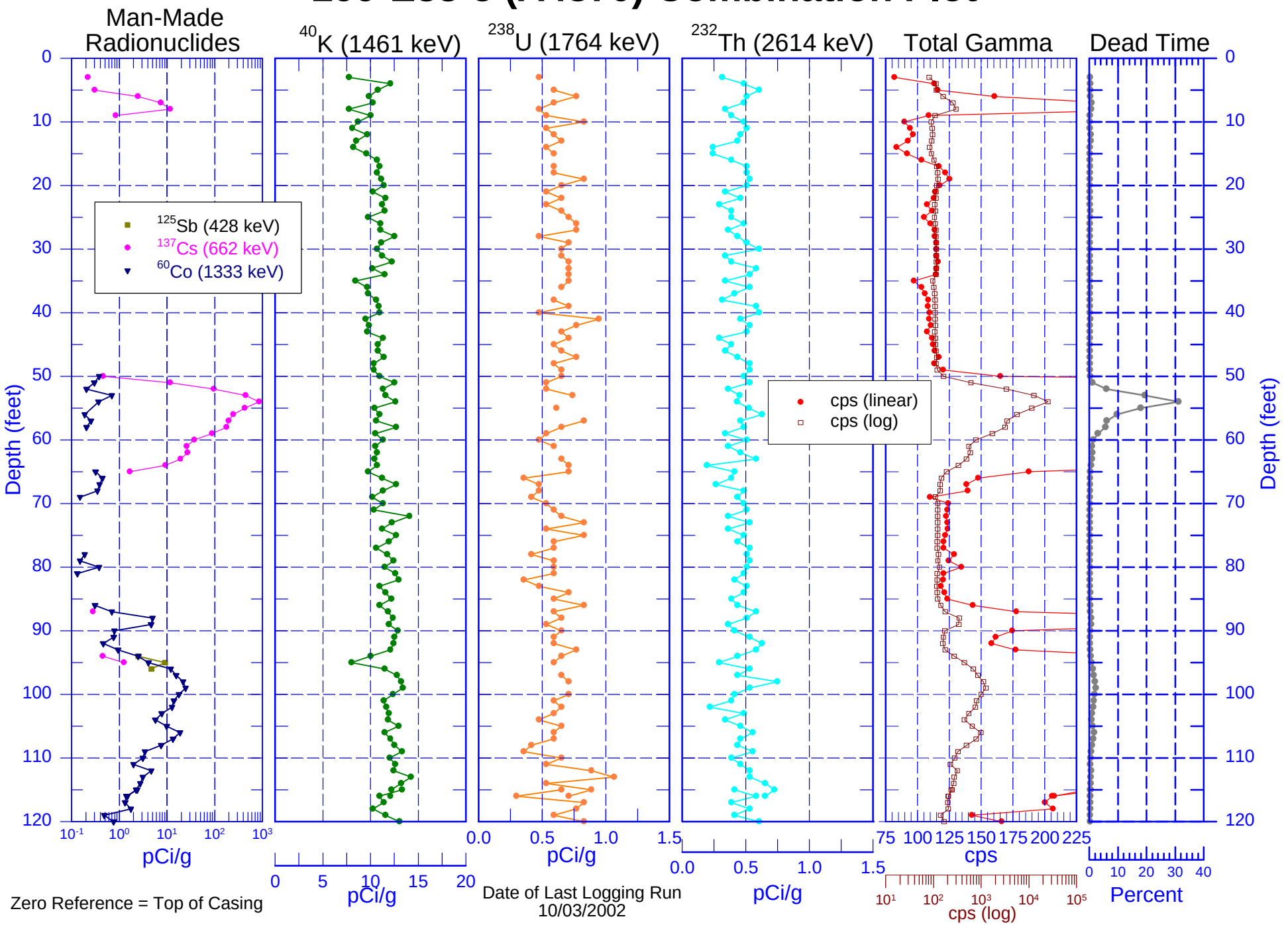
299-E33-5 (A4870)
Natural Gamma Logs



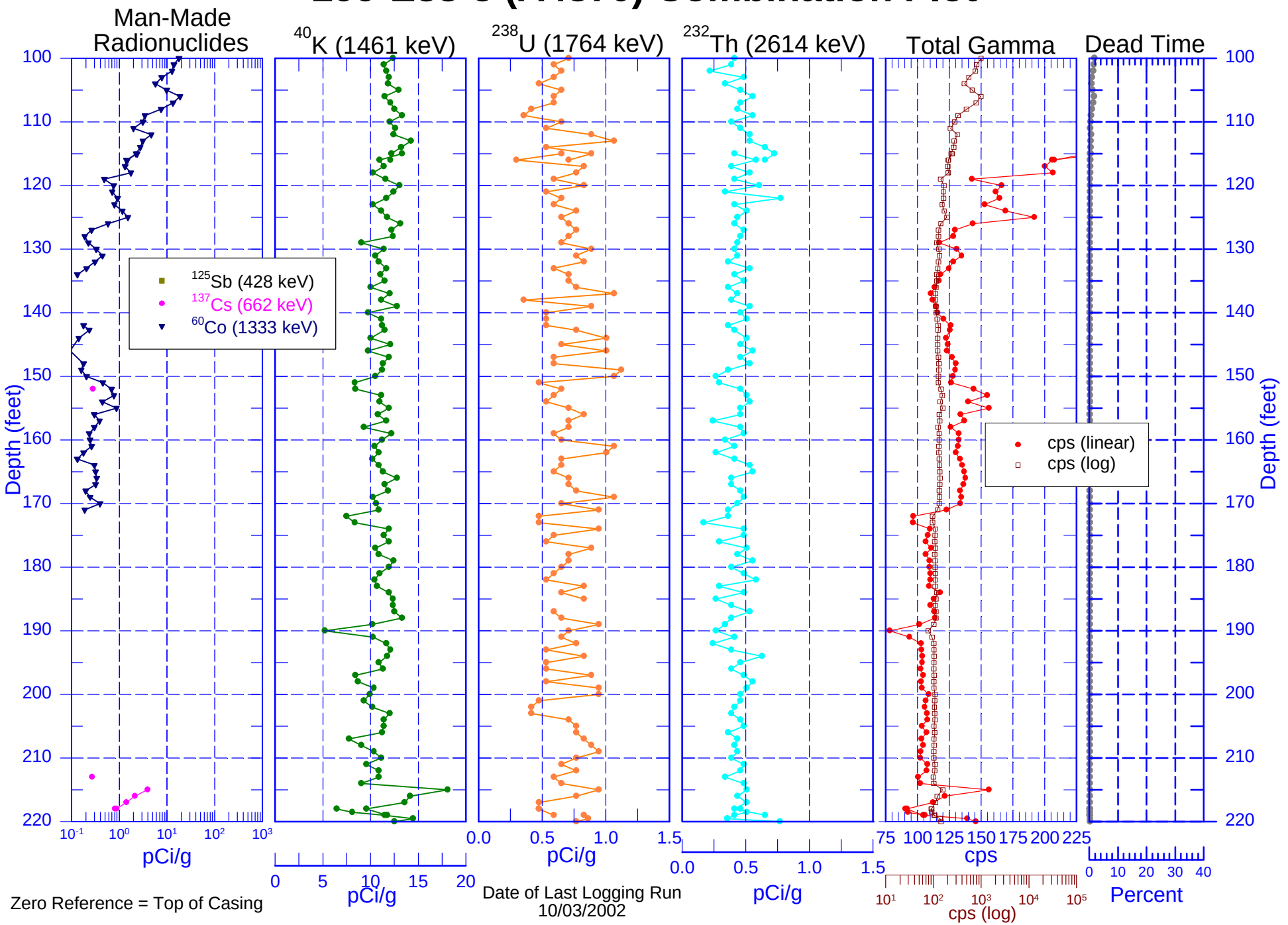
Zero Reference = Top of Casing

Date of Last Logging Run
10/03/2002

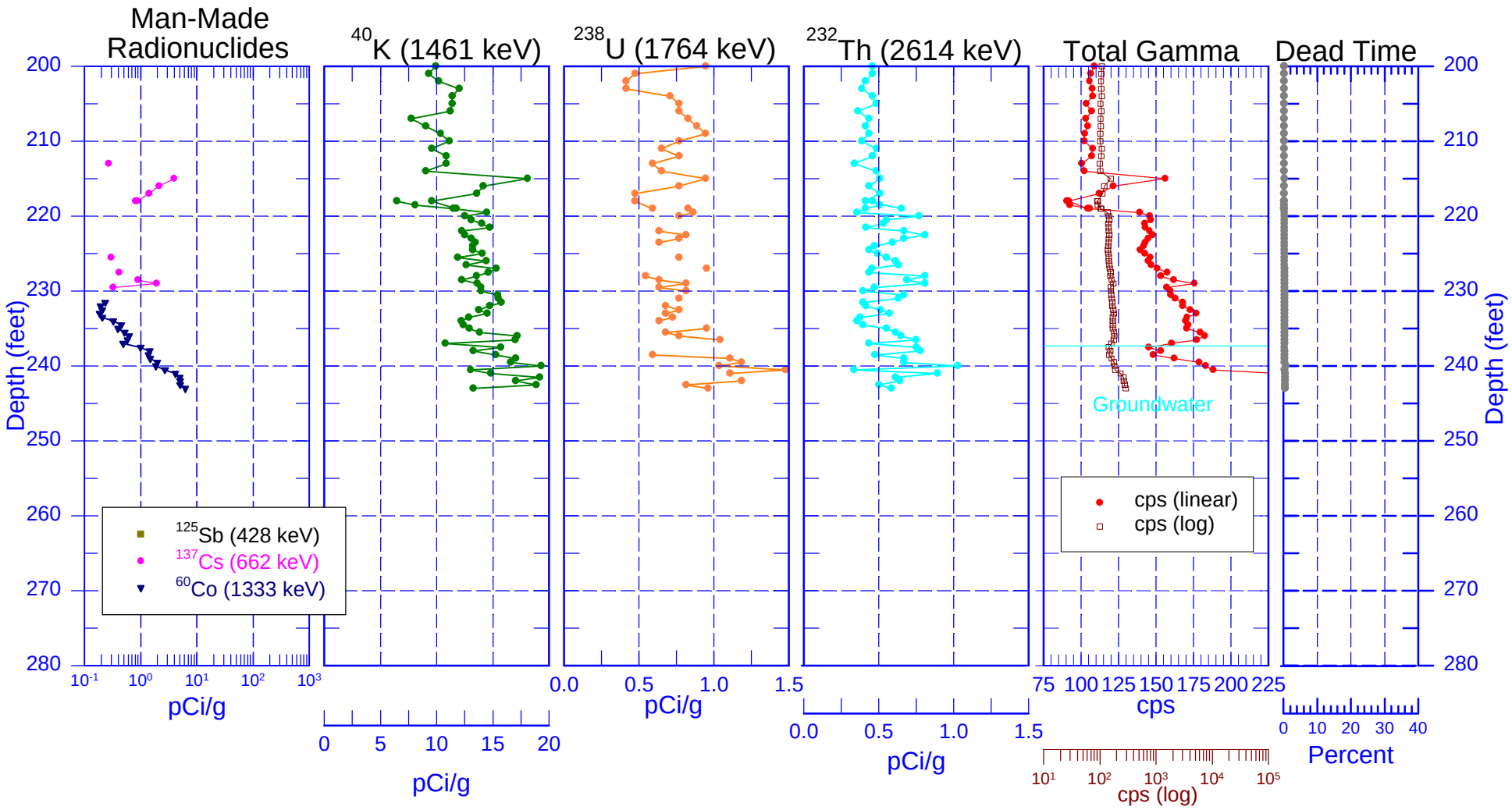
299-E33-5 (A4870) Combination Plot



299-E33-5 (A4870) Combination Plot



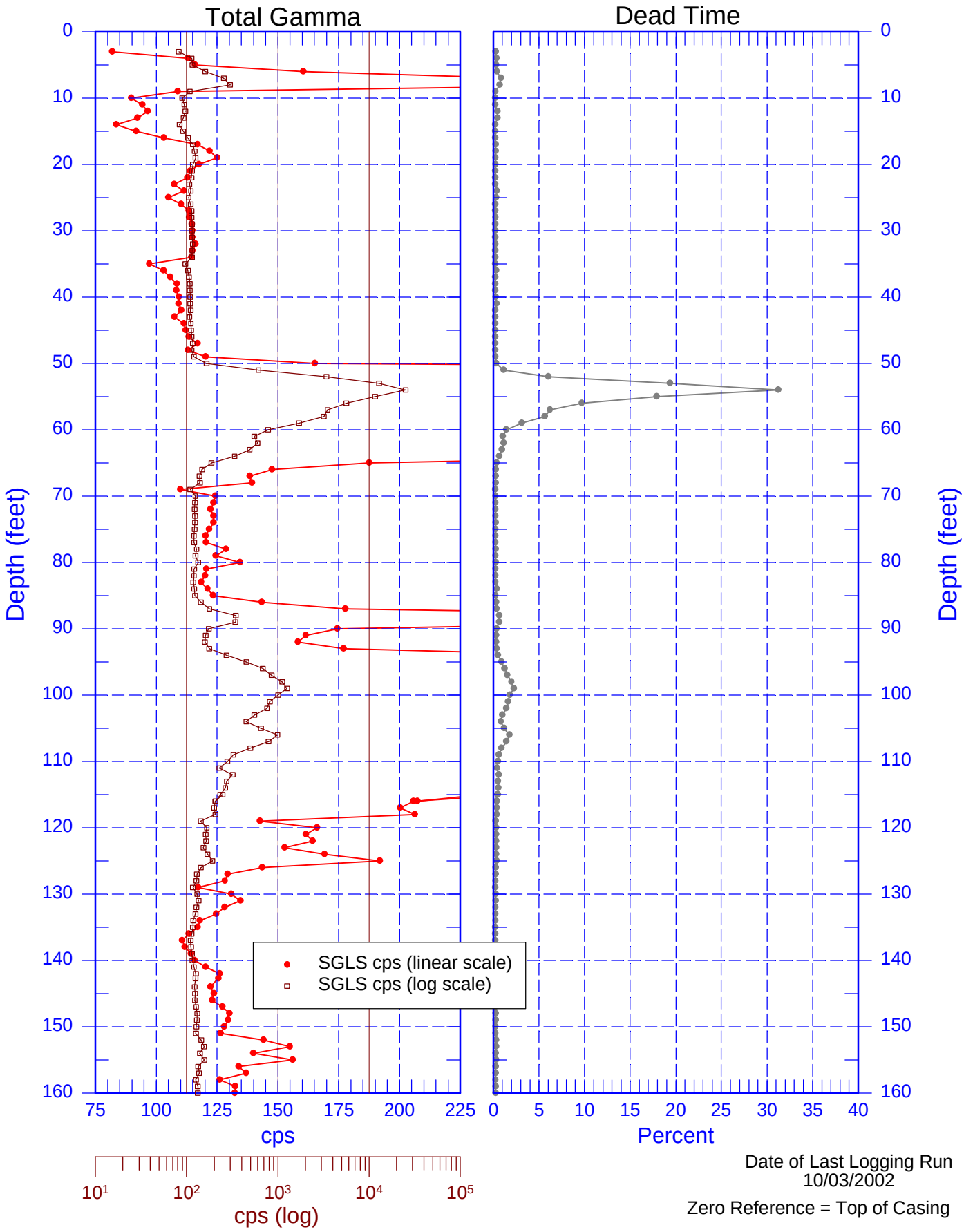
299-E33-5 (A4870) Combination Plot



Zero Reference = Top of Casing

Date of Last Logging Run
10/03/2002

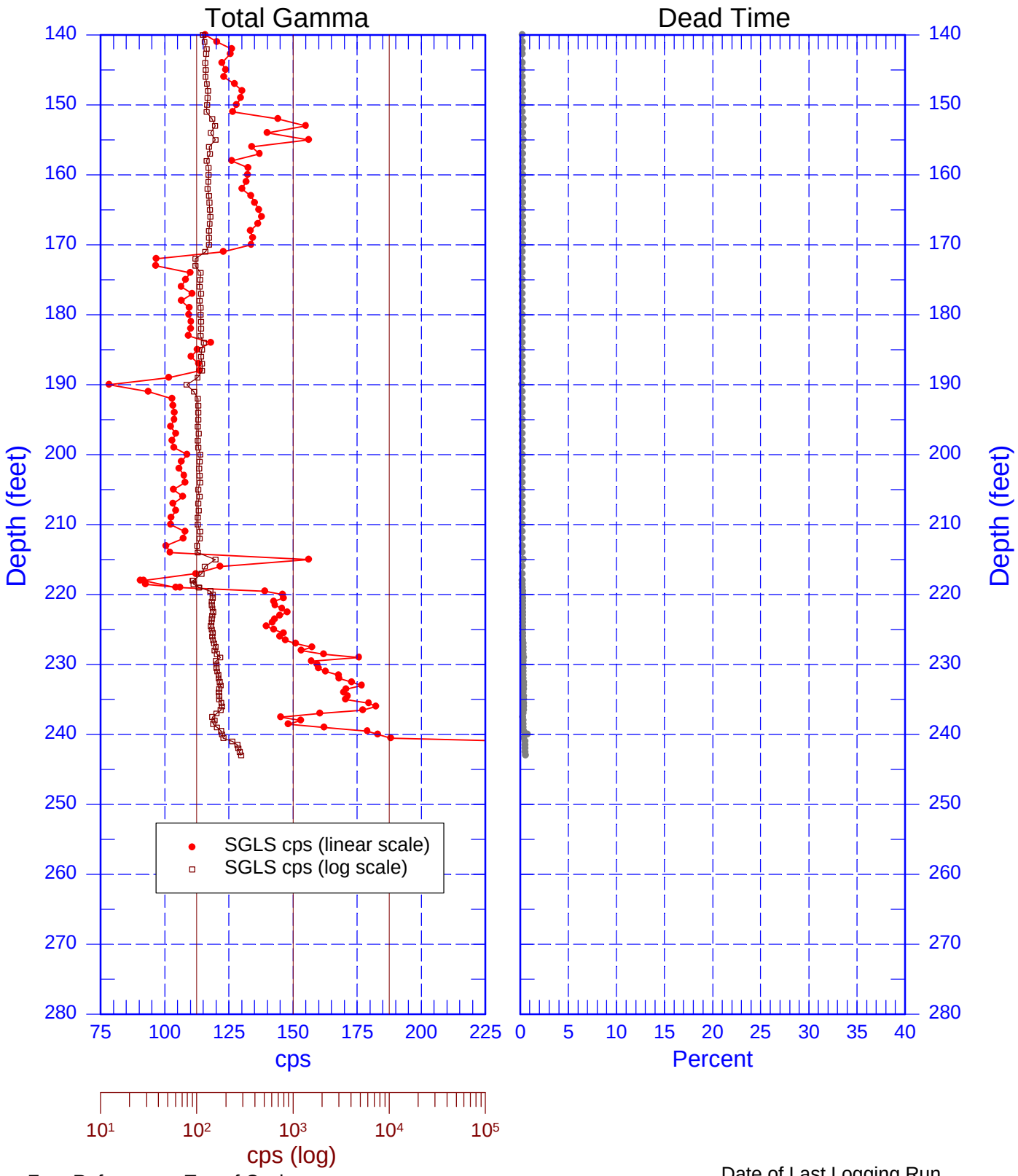
299-E33-5 (A4870)
Total Gamma & Dead Time



Date of Last Logging Run
10/03/2002

Zero Reference = Top of Casing

299-E33-5 (A4870)
Total Gamma & Dead Time



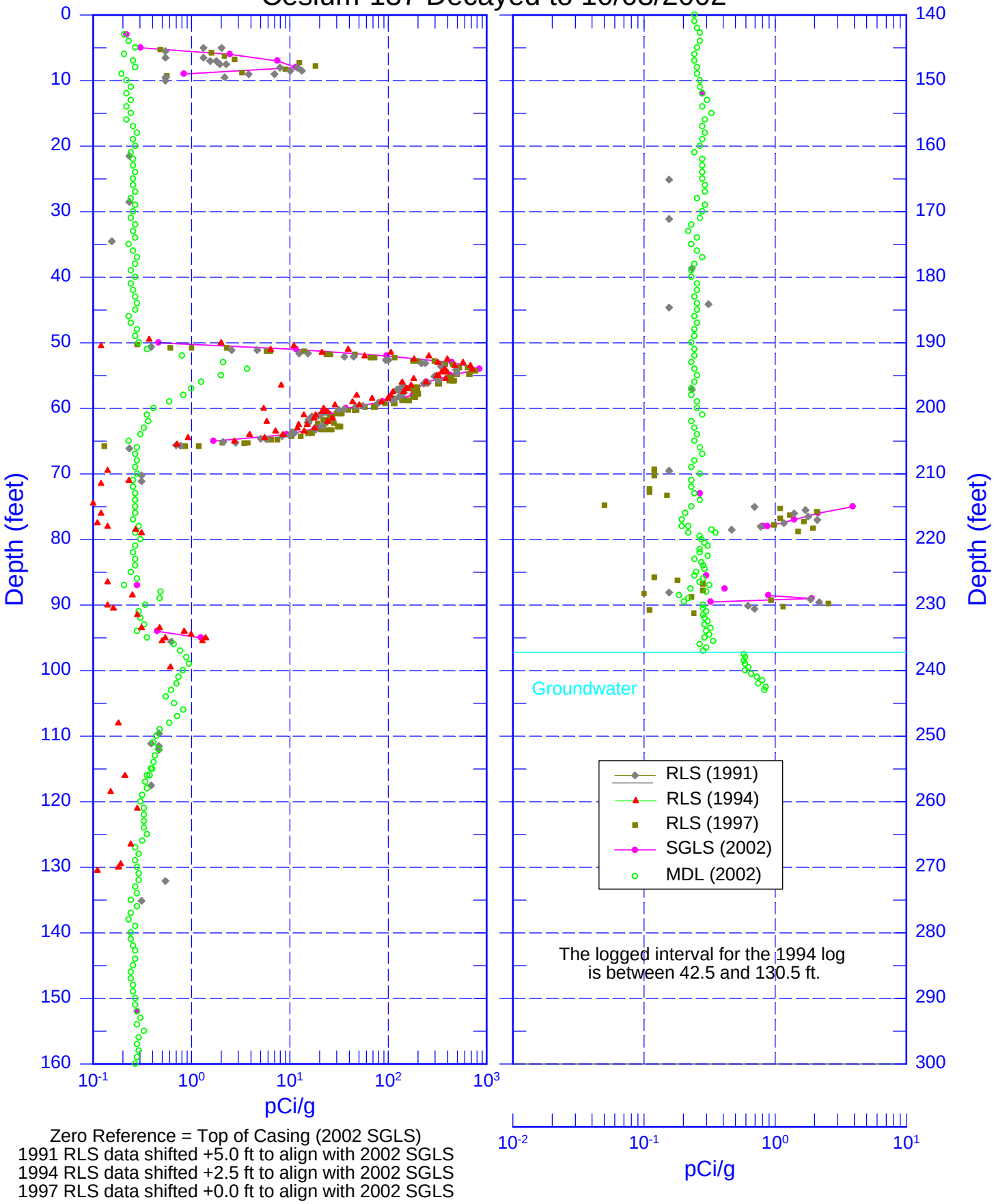
Zero Reference = Top of Casing

Date of Last Logging Run
10/03/2002

299-E33-5 (A4870)

RLS Data Compared to SGLS Data

Cesium-137 Decayed to 10/03/2002

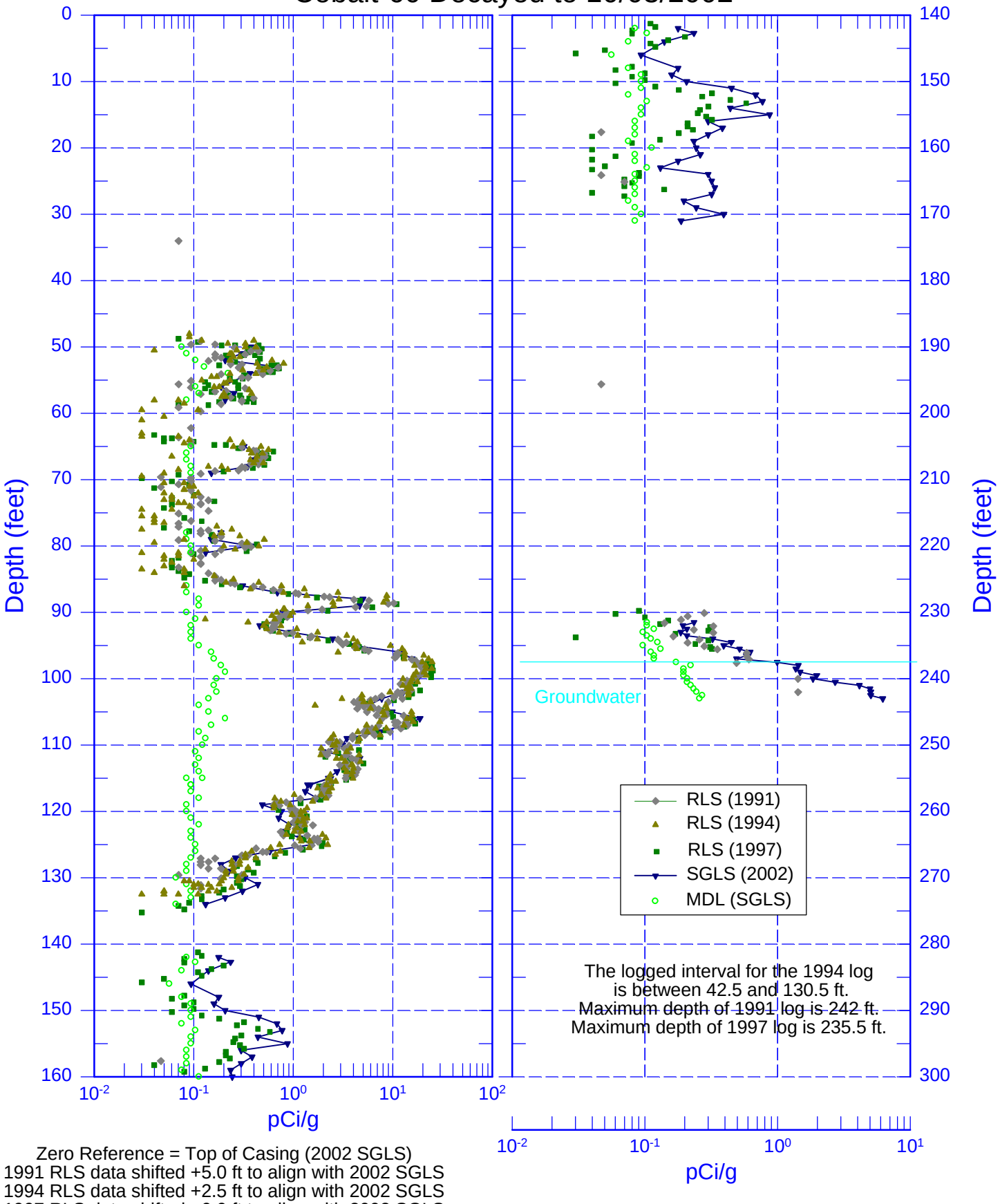


Zero Reference = Top of Casing (2002 SGLS)
1991 RLS data shifted +5.0 ft to align with 2002 SGLS
1994 RLS data shifted +2.5 ft to align with 2002 SGLS
1997 RLS data shifted +0.0 ft to align with 2002 SGLS

299-E33-5 (A4870)

RLS Data Compared to SGLS Data

Cobalt-60 Decayed to 10/03/2002

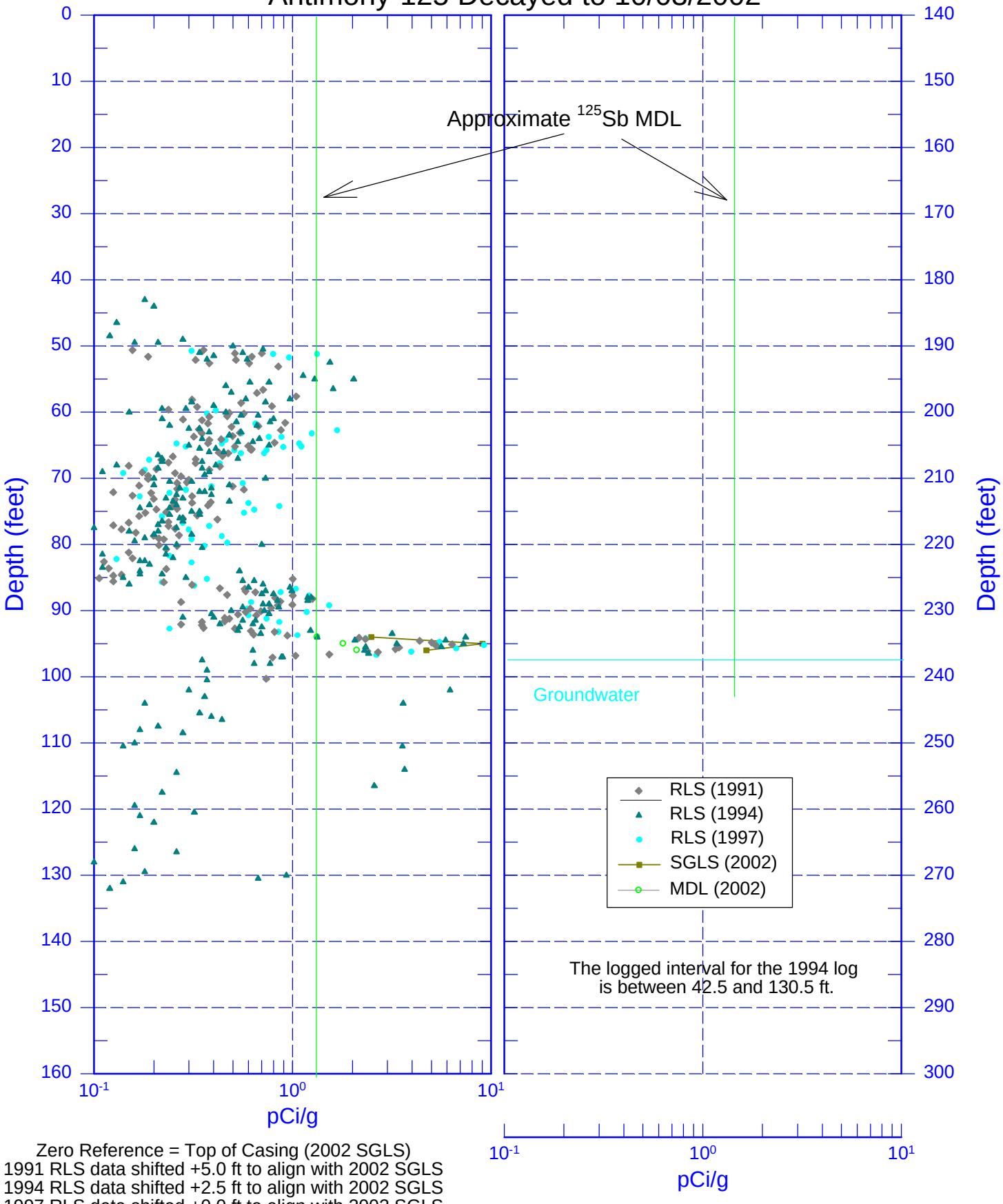


Zero Reference = Top of Casing (2002 SGLS)
1991 RLS data shifted +5.0 ft to align with 2002 SGLS
1994 RLS data shifted +2.5 ft to align with 2002 SGLS
1997 RLS data shifted +0.0 ft to align with 2002 SGLS

299-E33-5 (A4870)

RLS Data Compared to SGLS Data

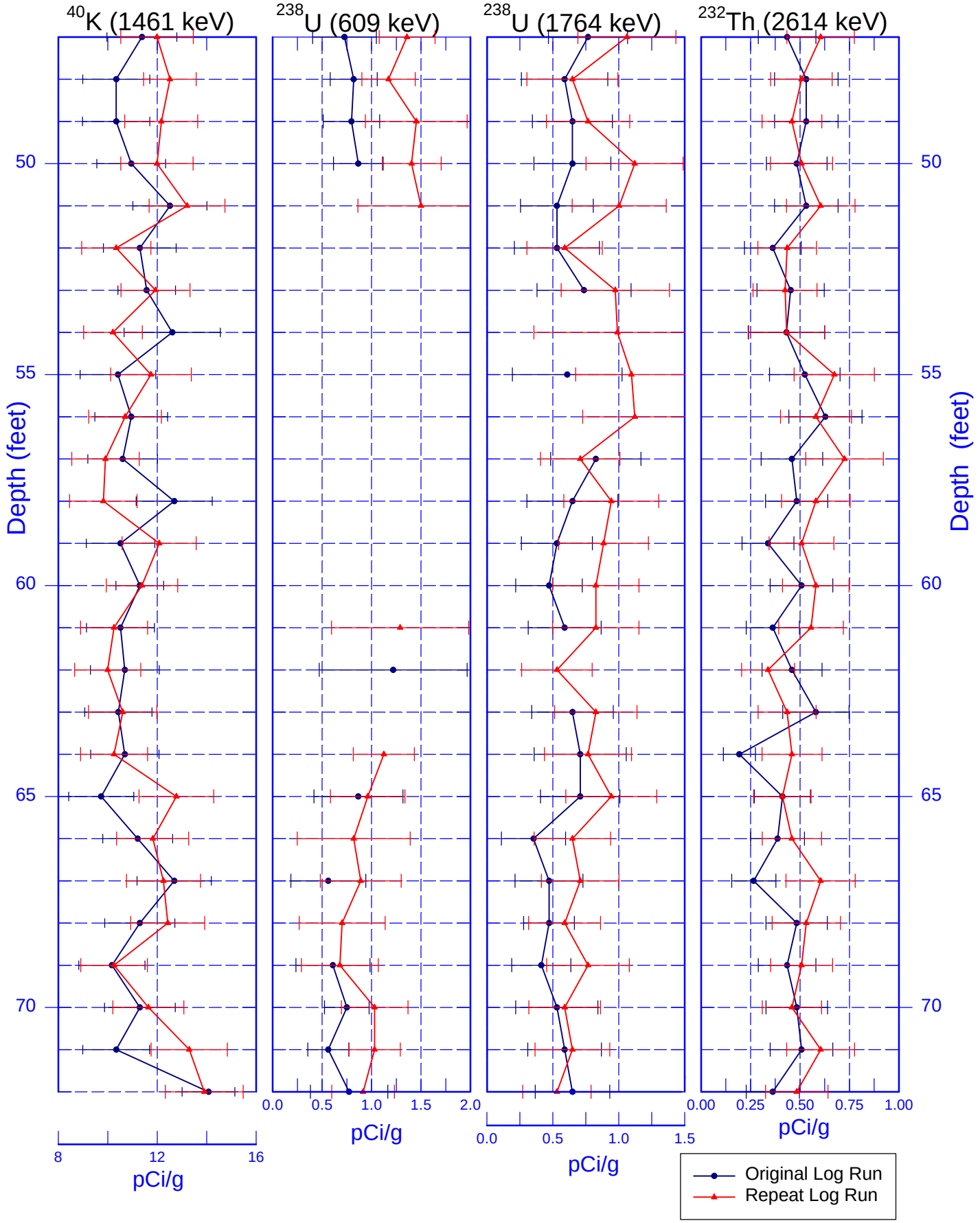
Antimony-125 Decayed to 10/03/2002



Zero Reference = Top of Casing (2002 SGLS)
1991 RLS data shifted +5.0 ft to align with 2002 SGLS
1994 RLS data shifted +2.5 ft to align with 2002 SGLS
1997 RLS data shifted +0.0 ft to align with 2002 SGLS

299-E33-5 (A4870)

Rerun of Natural Gamma Logs (72.0 to 47.0 ft)



299-E33-5 (A4870)

Rerun of Man-Made Radionuclides (72.0 to 47.0 ft)